A Bird's Eye View on Air Quality

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Langley Research Center

Science is for Everyone Webinar: The Air You Breathe

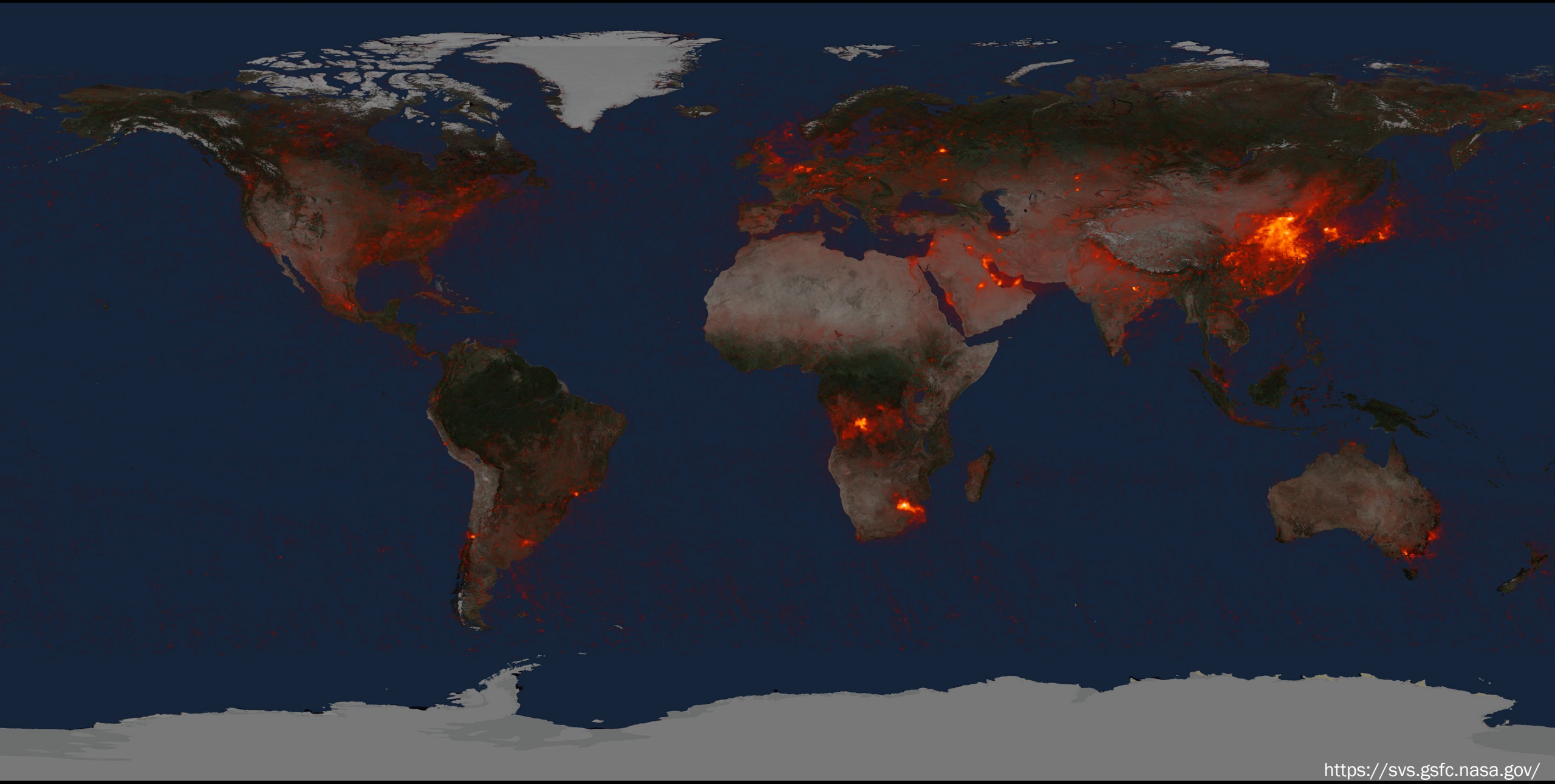
26 January 2022

Nitrogen Dioxide (NO_2)

Tropospheric Column Amount (molescules/cm^2)

0 10e15 20e15

2017-07-01

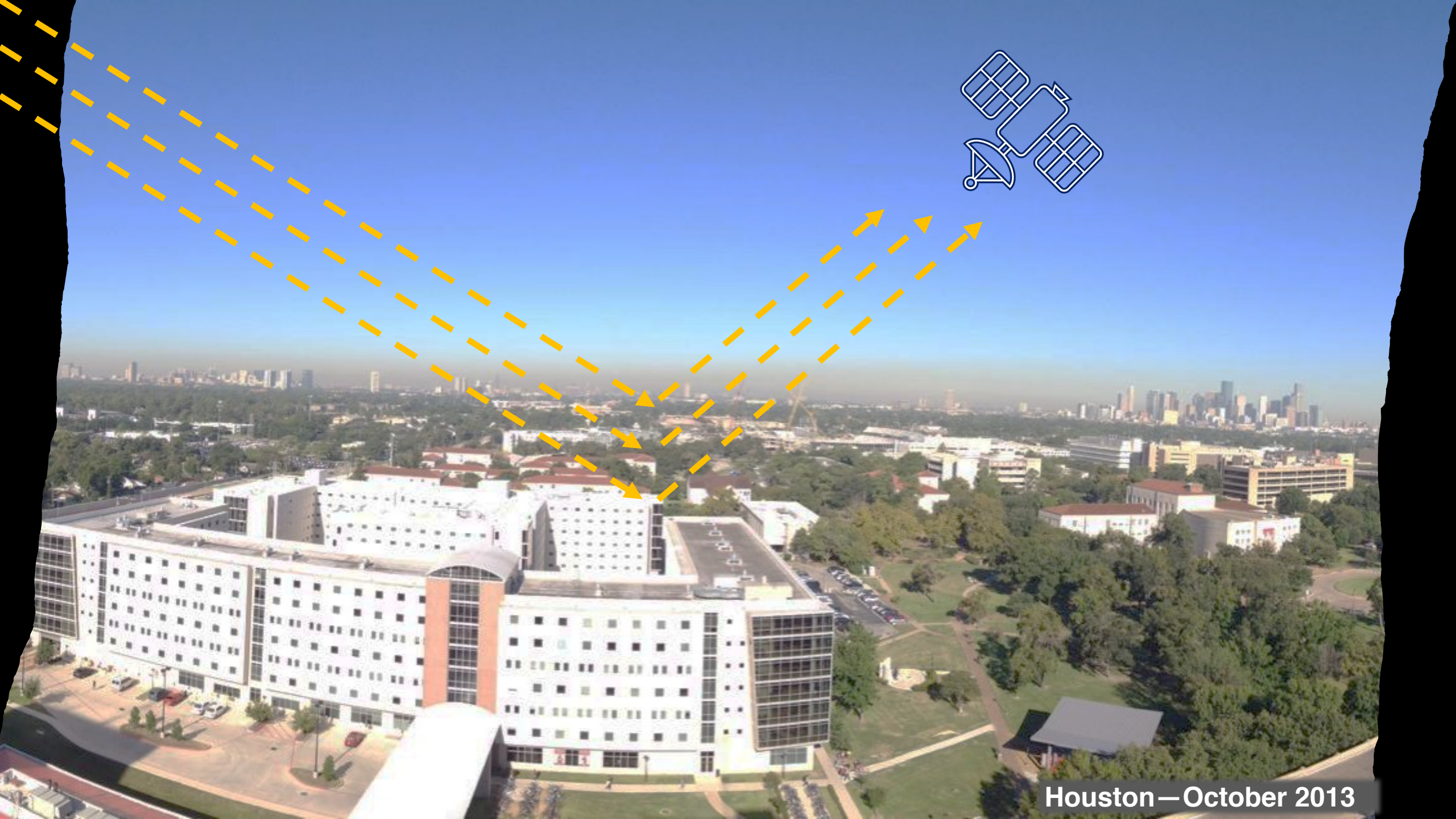


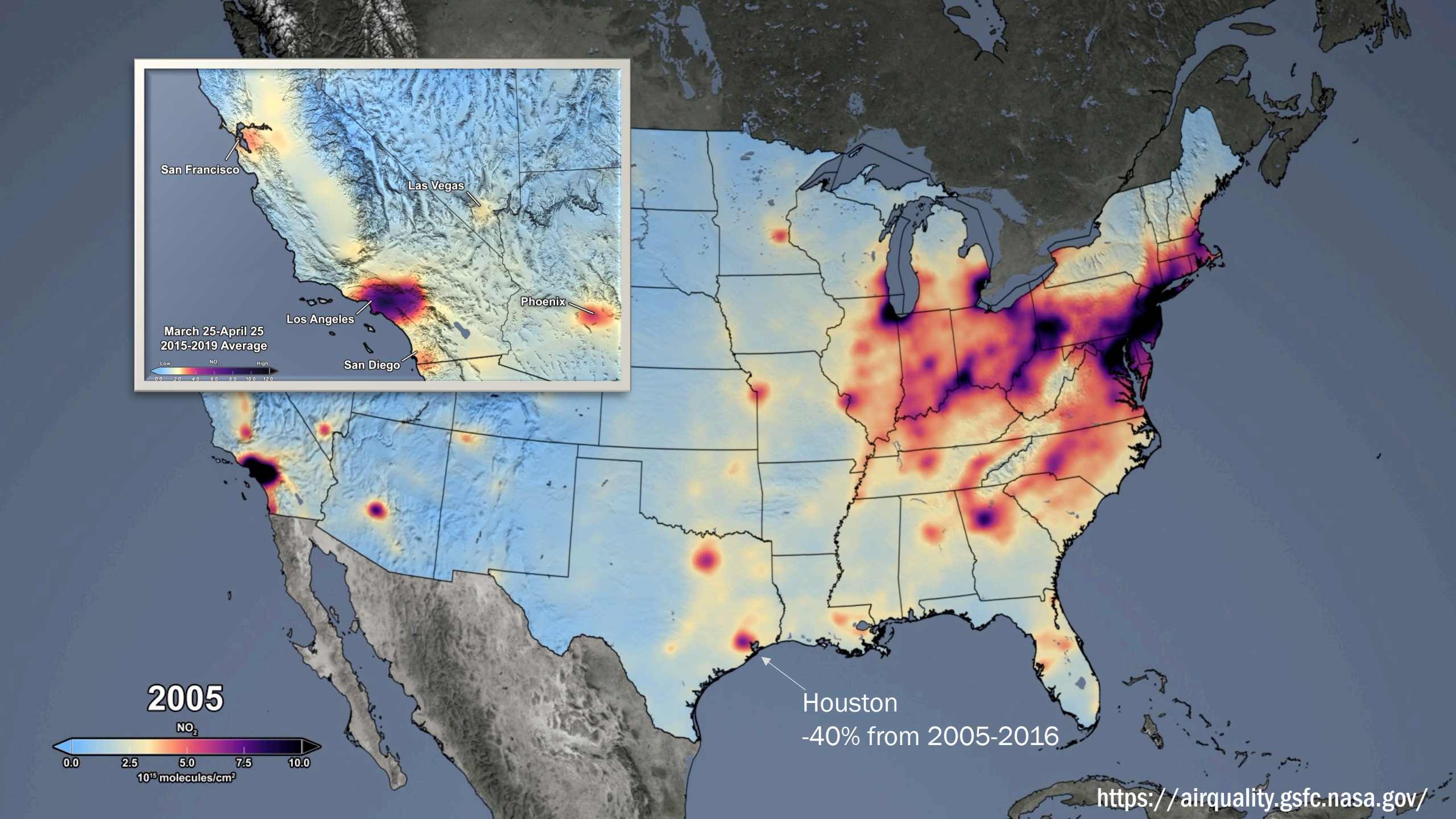
https://svs.gsfc.nasa.gov/

Global Sampling from the Ozone Monitoring Instrument (OMI) 2004-Present

TROPOMI-a newer air quality satellite sensor launched by ESA in 2017—observes very similarly but at a finer spatial scale

https://svs.gsfc.nasa.gov/

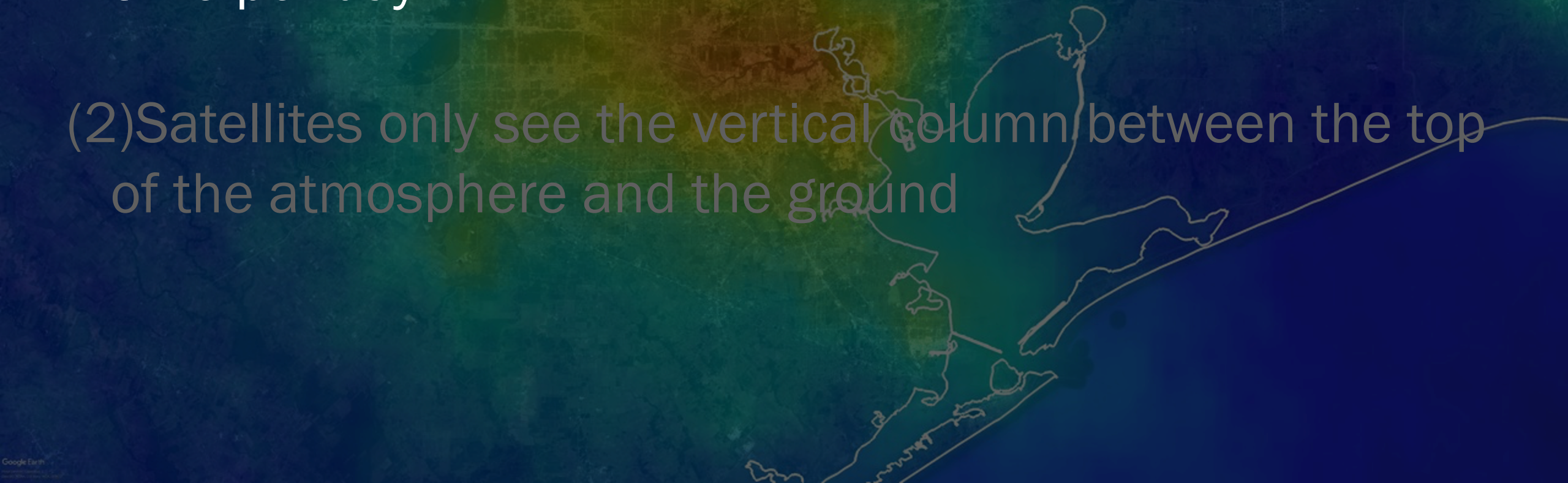

Houston—October 2013

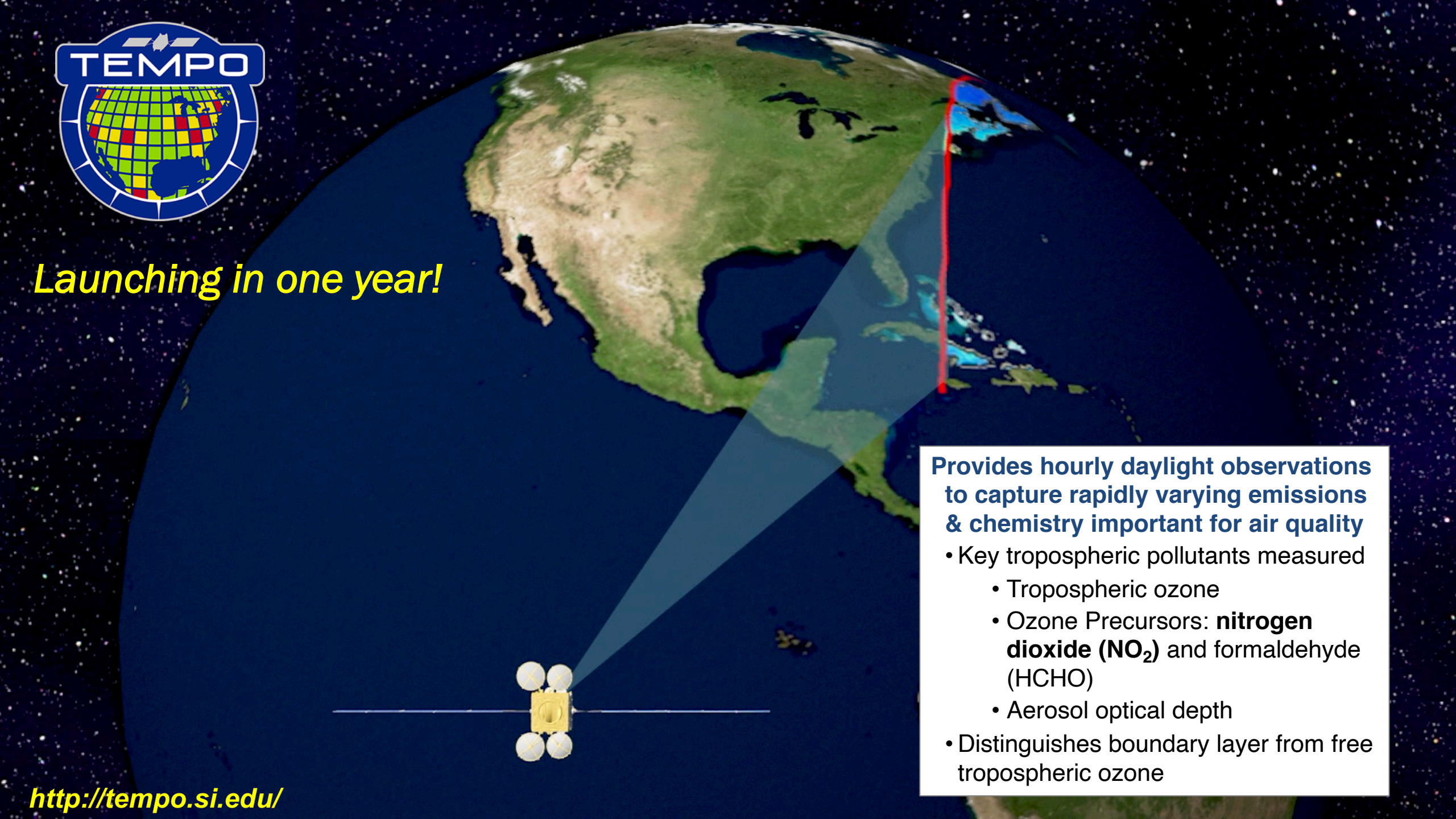

San Francisco
Las Vegas
Phoenix
Los Angeles
San Diego
March 25-April 25
2015-2019 Average
Low
NO2
High
0.0 2.0 4.0 6.0 8.0 10.0 12.0
2005
NO2
0.0 2.5 5.0 7.5 10.0
10^15 molecules/cm^2
Houston
-40% from 2005-2016
https://airquality.gsfc.nasa.gov/

Challenges with Satellite NO_2 Data

(1)Current Satellites measuring NO_2 only get <u>maybe</u> one time per day

(2)Satellites only see the vertical column between the top of the atmosphere and the ground



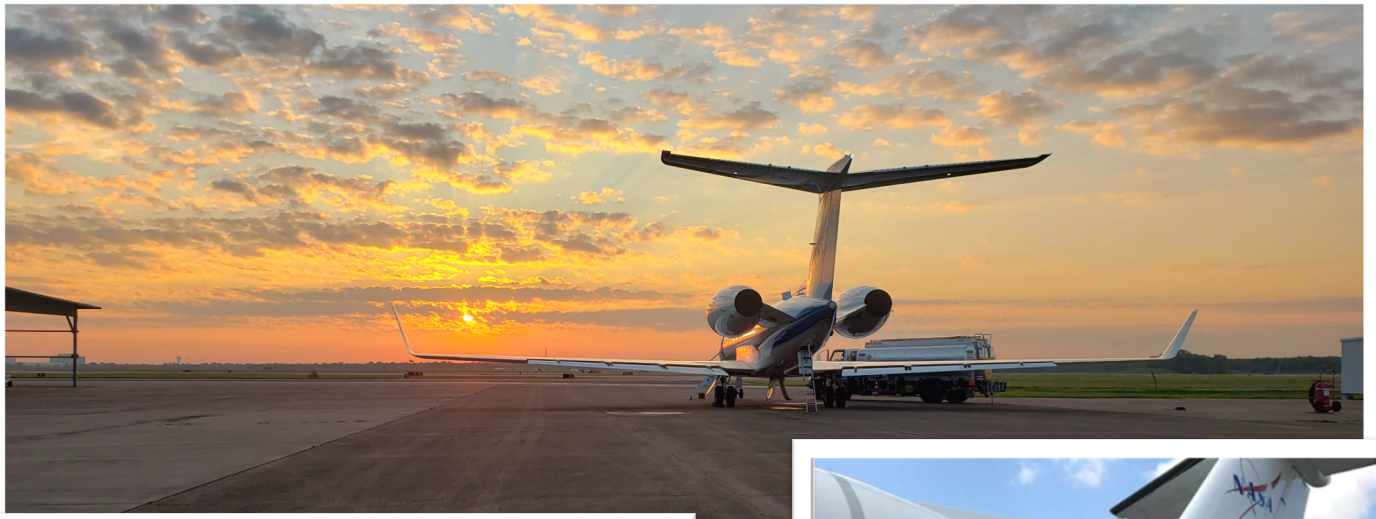


Launching in one year!

Provides hourly daylight observations to capture rapidly varying emissions & chemistry important for air quality

- Key tropospheric pollutants measured
  - Tropospheric ozone
  - Ozone Precursors: **nitrogen dioxide (NO_2)** and formaldehyde (HCHO)
  - Aerosol optical depth
- Distinguishes boundary layer from free tropospheric ozone

http://tempo.si.edu/




NASA
National Aeronautics and Space Administration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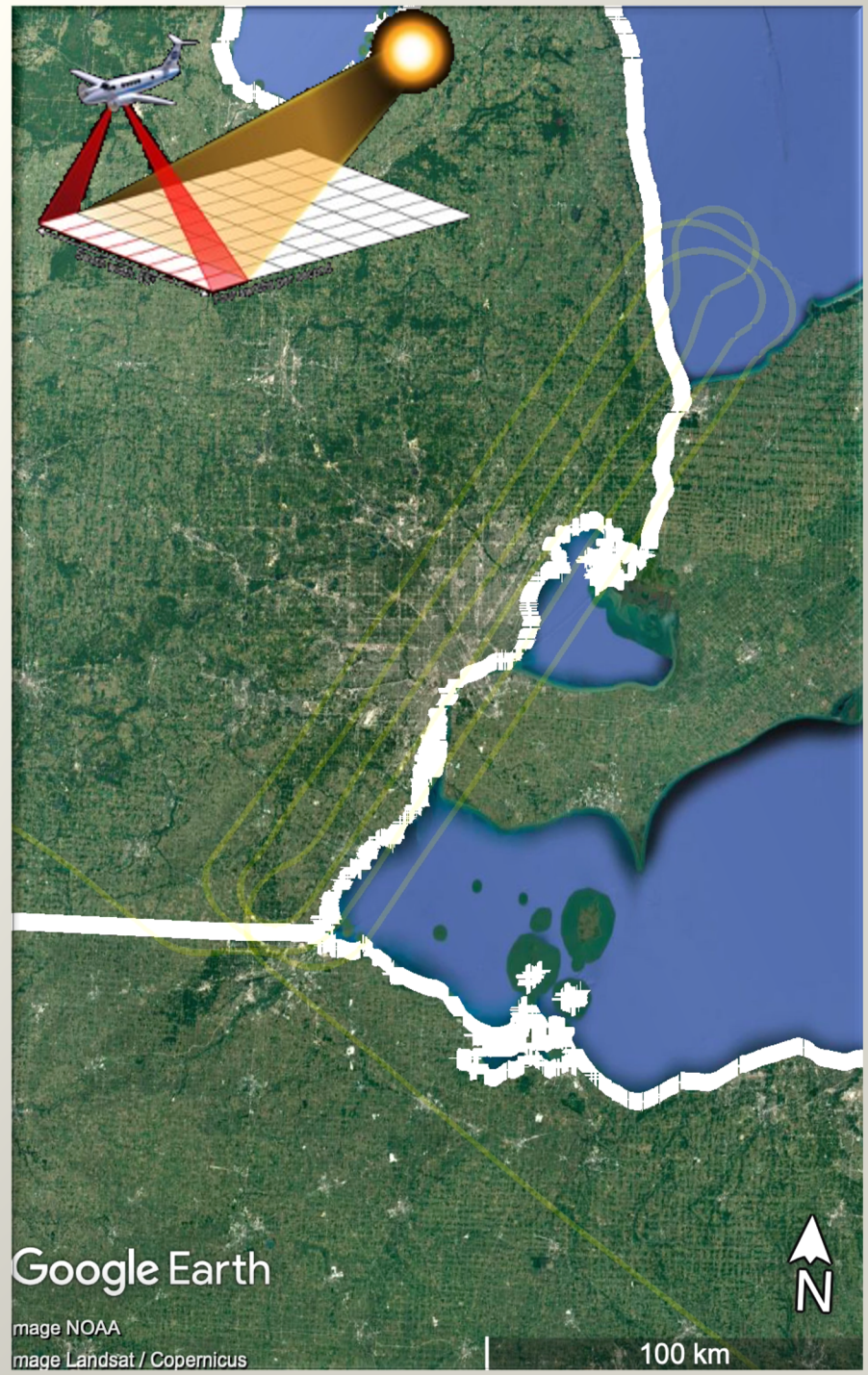
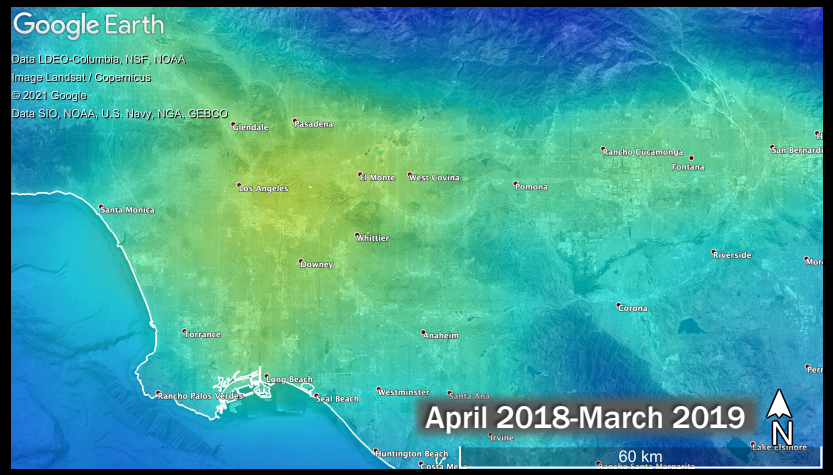
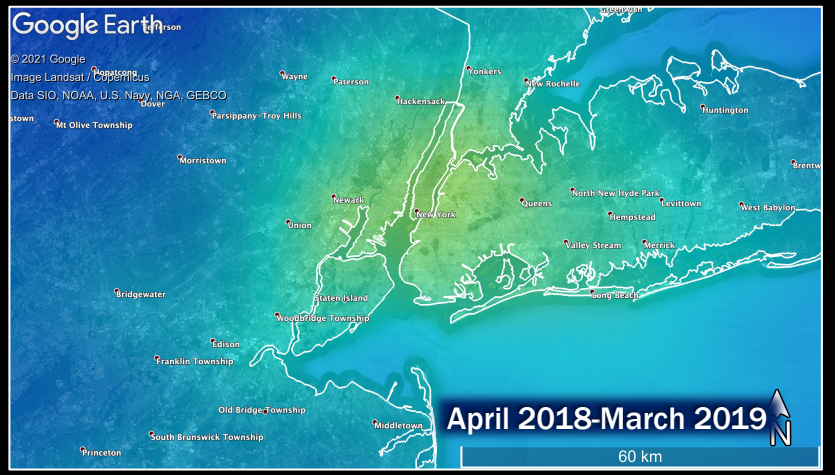
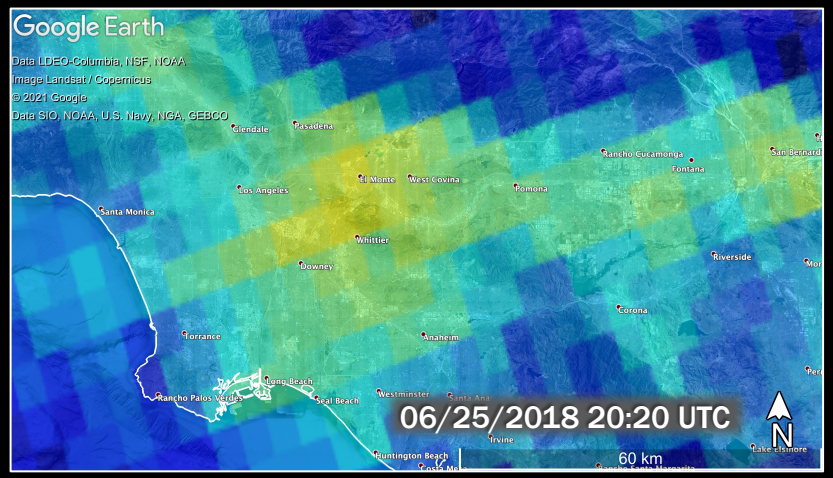

Google Earth
mage NOAA
mage Landsat / Copernicus
100 km
N

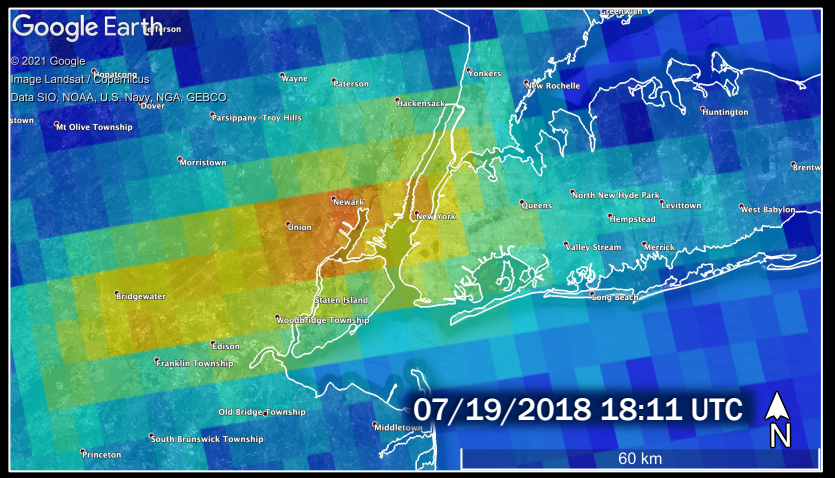


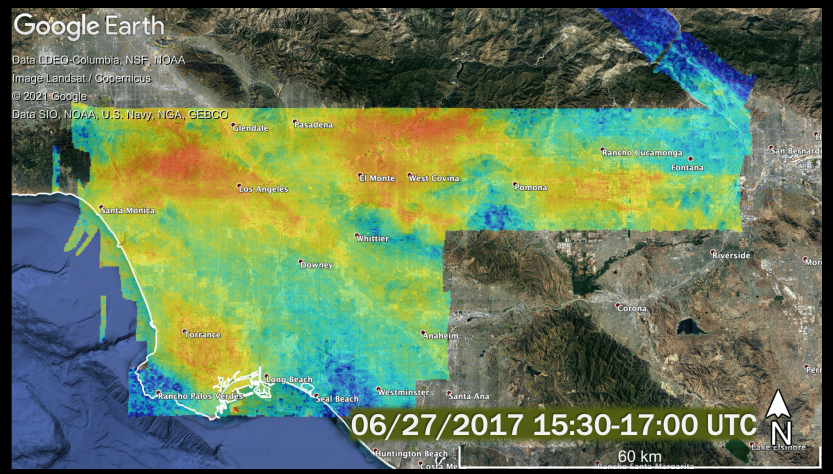
←Annual average from S5P TROPOMI→



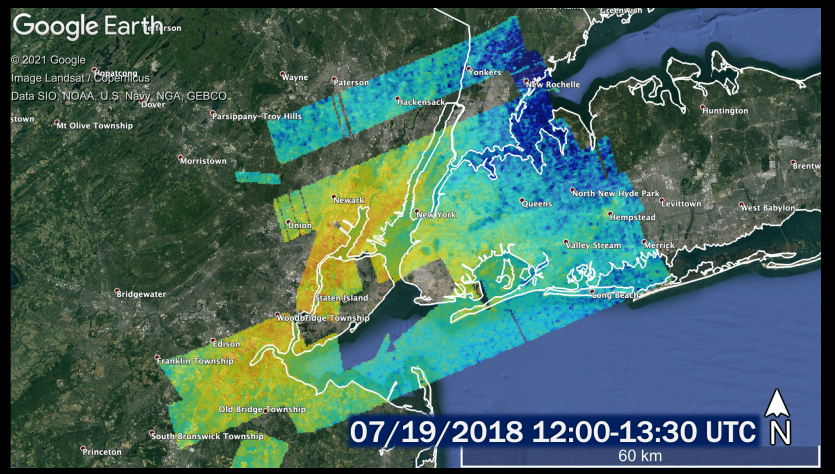


←Single overpass from S5P TROPOMI→





←High-resolution airborne measurements→



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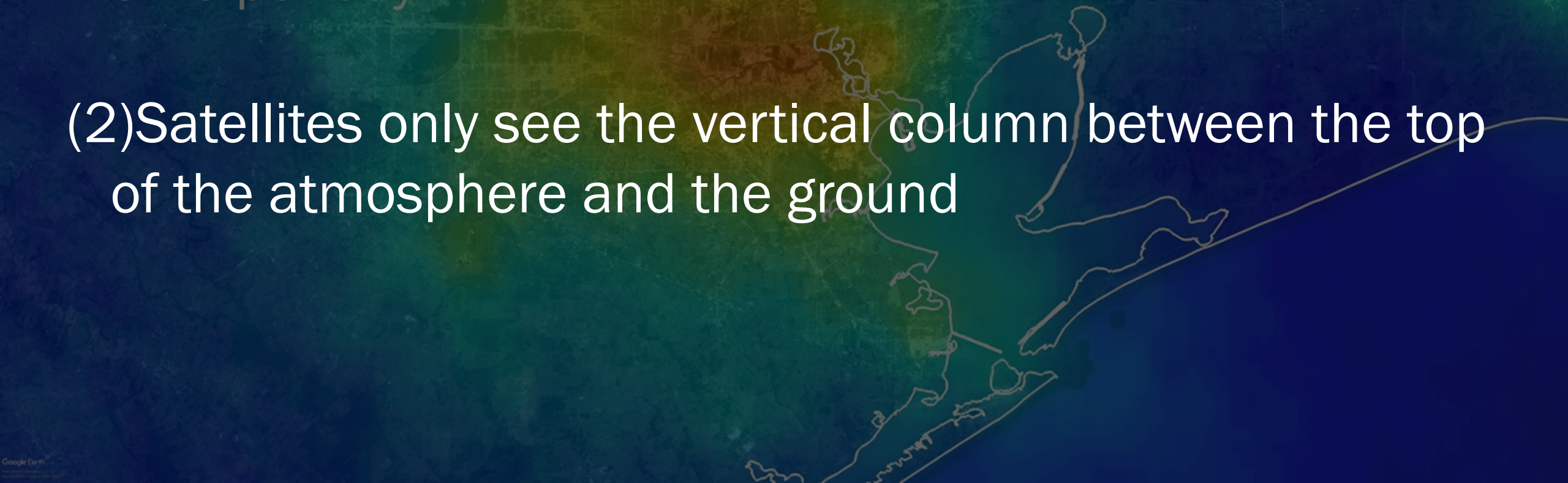
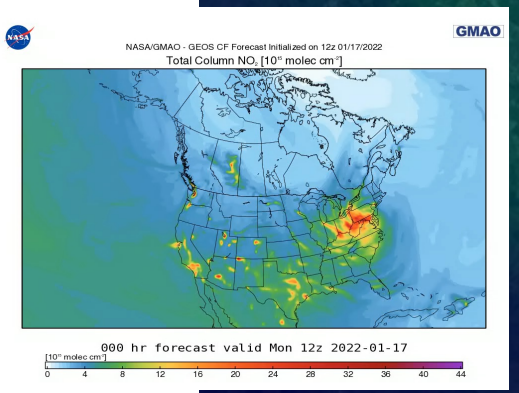


How do these ‘bird’s eye’ perspectives make a difference in our air quality?

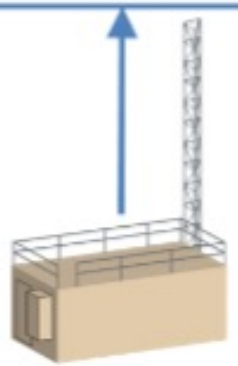
Satellite Observations



Research Aircraft

Improved Air Quality Understanding

Air Quality Models



Air Quality Monitoring and Research Observations

TRACER-AQ:

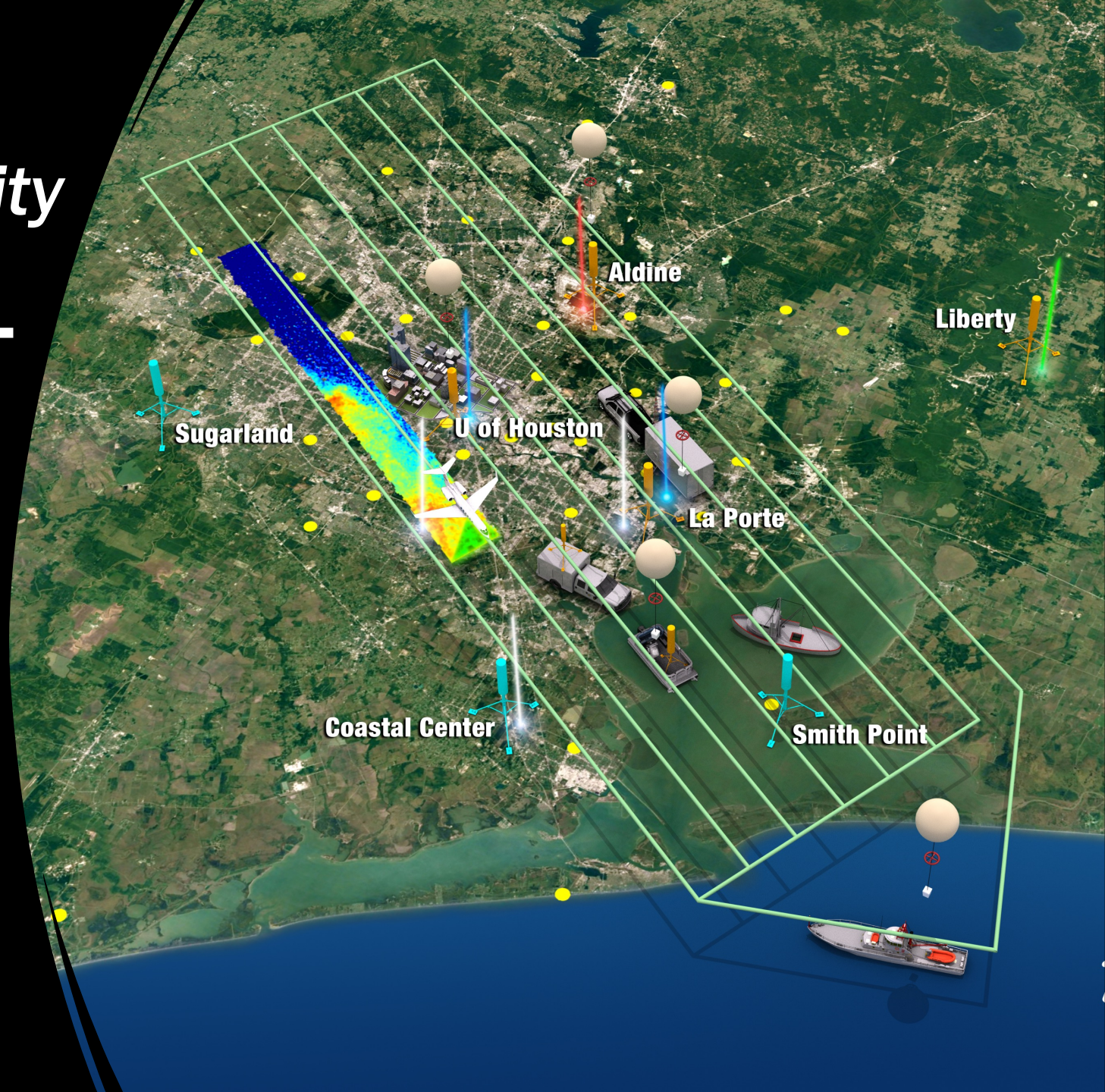
A Houston-based air quality experiment in 2021

TRACER-AQ is a NASA-led air quality component with partners from TCEQ and a number of academic institutions with observations from aircraft, boats, mobile labs, and ground sites.

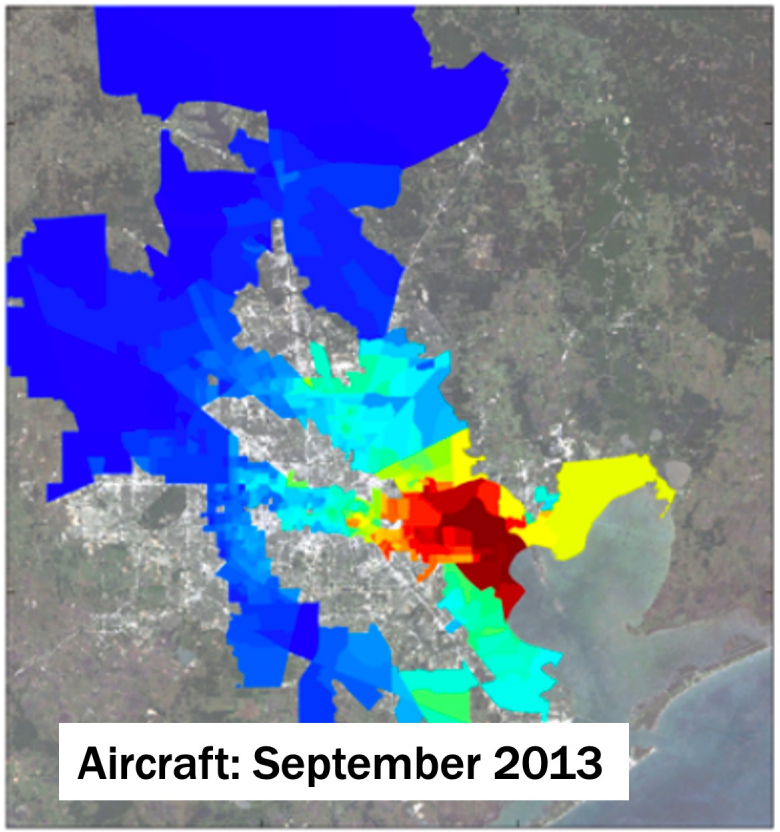
TRACER-AQ Science Focus Areas:

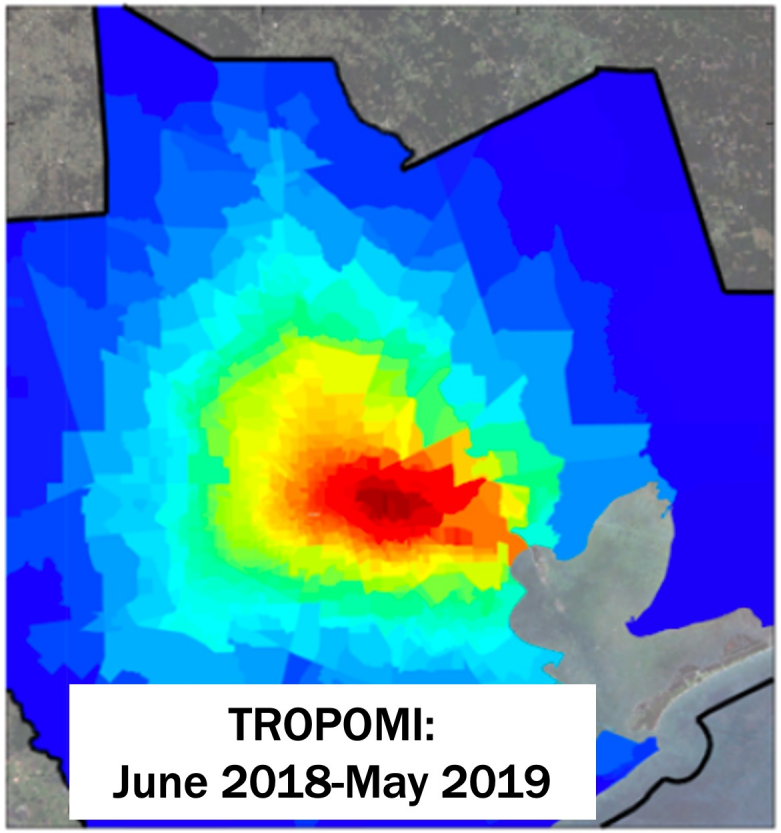
1. Ozone Photochemistry and Meteorology
2. Modeling and Satellite Evaluation
3. Intersection of Air Quality and Socioeconomic Factors

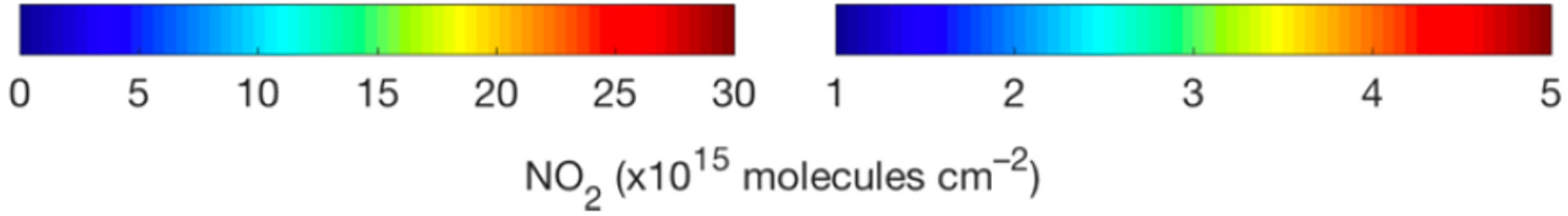
https://www.nasa.gov/feature/langley/nasa-study-examines-houston-area-air-quality-issues/

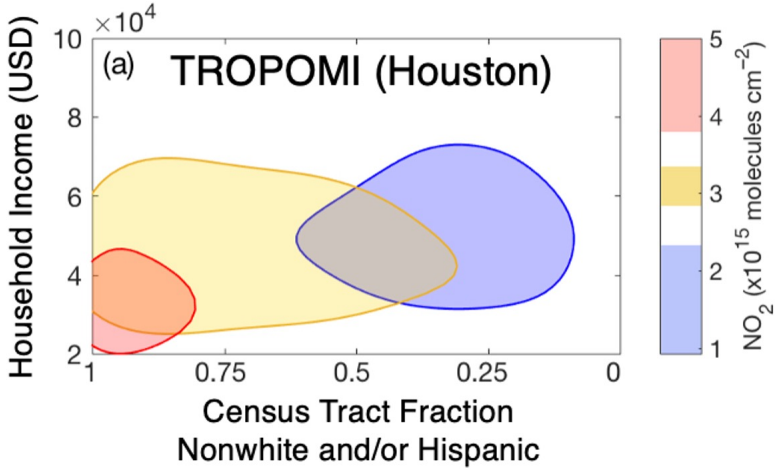


Houston, Texas









NO_2 was 37% higher for non-whites and Hispanics living in low-income tracts compared to whites living in high-income tracts in September 2013.

Results with TROPOMI show that a 65% reduction in diesel NO_x emissions will reduce NO_2 inequality by 50% in Houston.

Demetillo et al. (2020):
https://dx.doi.org/10.1021/acs.est.0c01864
Demetillo et al. (2021):
https://doi.org/10.1029/2021GL094333

Take-home thoughts:

(1)Satellites provide a global-to-local view of our imprint on emissions related to fossil fuels through the indicator, NO_2.

(2)Our view is expanding through the additional of hourly observations from satellite and aircraft providing air quality management and scientists with information to help us continue to combat air pollution.

(3)Improving air quality requires us to work together puzzling together data from multiple perspectives like aircraft, ground monitoring, and models.

What is your current air quality?

- Recommend airnow.gov

Want to learn more?

- Check out arset.nasa.gov

Thank you for your attention today!